University of Montenegro
Faculty of Electrical Engineering
Podgorica

Laboratorijske vježbe iz predmeta Industrijska elektronika

Zero crossing detector i regulisanje ugla paljenja tiristora/triaka
Zero crossing detector and angle firing

(Vježba 4)

Predmetni nastavnik/Professor: prof. Dr Radovan Stojanović

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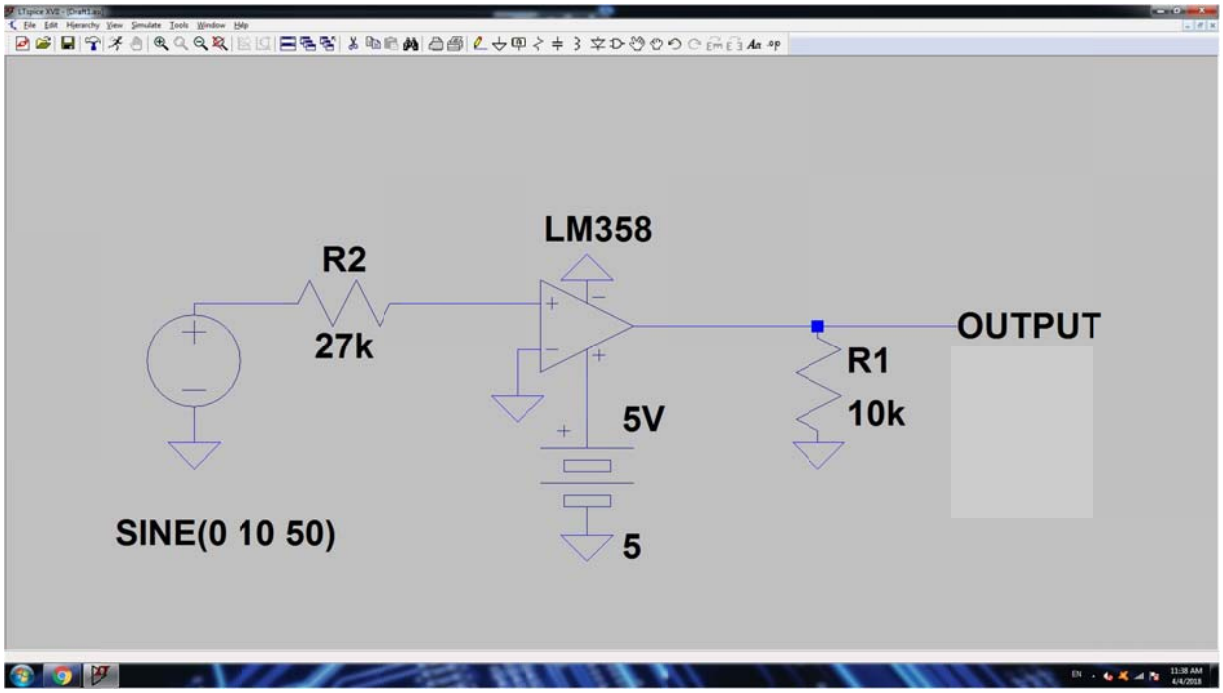
Zadatak:

Koristeći kolo LM358, LM324 i signal generator (podešen na sinusoidu amplitude 10V I frekvencije 50Hz):

a)(grupa1-2) Projektovati zero crossing kolo koje na svom izlazu daje impulse +5V(trajanja 10us) svakog trenutka kada sinusoida prolazi kroz 0 iz pozitivne u negativnu ili iz negativne u pozitivnu poluperiodu. Sinhro circuit1.

b) (grupa 3-4) Generisati impuls paljenja tiristora/triaka. Ugao paljenja se podešava sa dva tastera–veći manji ugao. Koristiti Sinhro circuit1 podešen na 50Hz.

Grupa 1-2 Zero crossing detector



Slika 1. Šema zero crossing detektora. LT spice

Abstract:

A **zero-crossing** is a point where the sign of a mathematical function changes (e.g. from positive to negative), represented by a intercept of the axis (zero value) in the graph of the function.

Zero crossing detector is used to detect a sine waveform transition from positive to negative and vice versa. It can also be called as the sine to square wave converter. Actually, it is a voltage comparator which uses operational amplifier to compare two voltages. The point where the AC line voltage is 0 V is the Zero Cross Point. Resistor R2 limits the current and R1 reduces the offset problem.

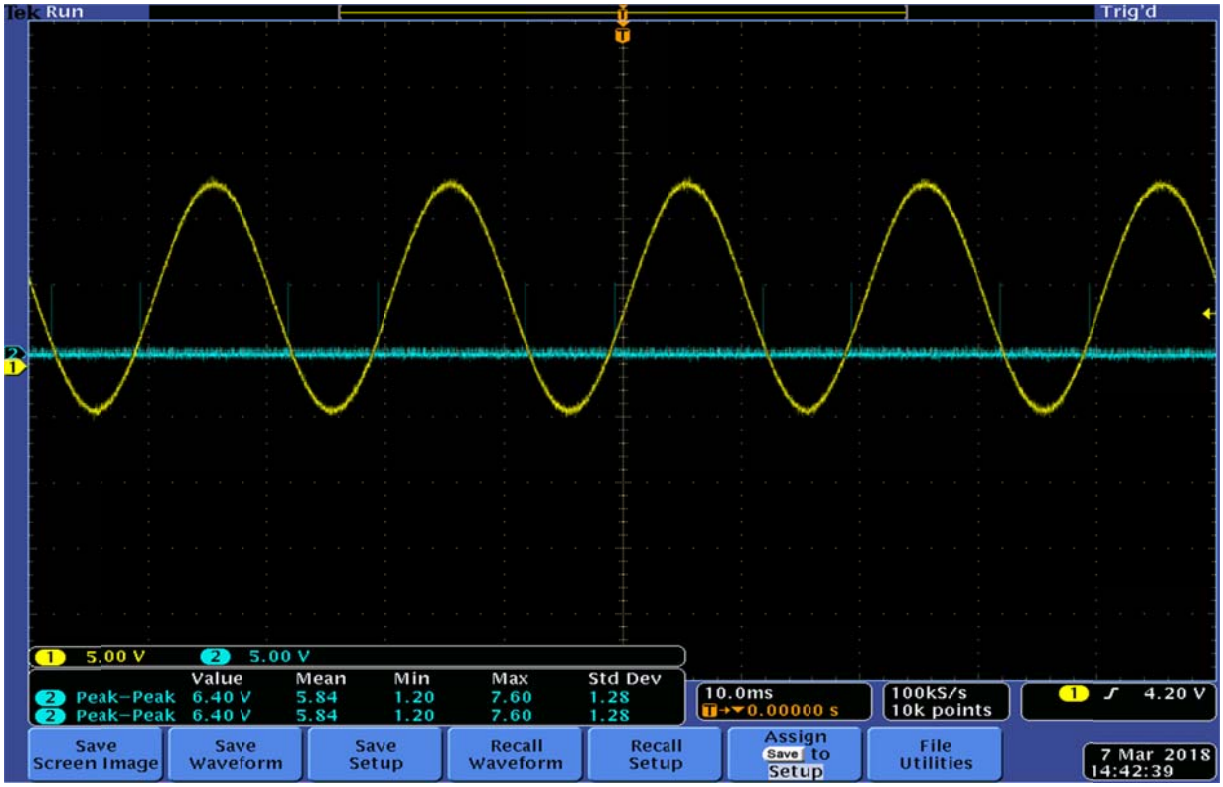
Objašnjenje:

Realizovali smo kolo detektora nule koristeći Arduino Uno i operacioni pojačavač LM358. Ovo kolo se koristi za detektovanje prelaza signala iz negativne u pozitivnu poluperiodu i obrnuto. Rezultat smo prikazali i putem osciloskopa na kom se jasno vidi detektovana tranzicija sinusnog signala iz pozitivne i negativnu poluperiodu.

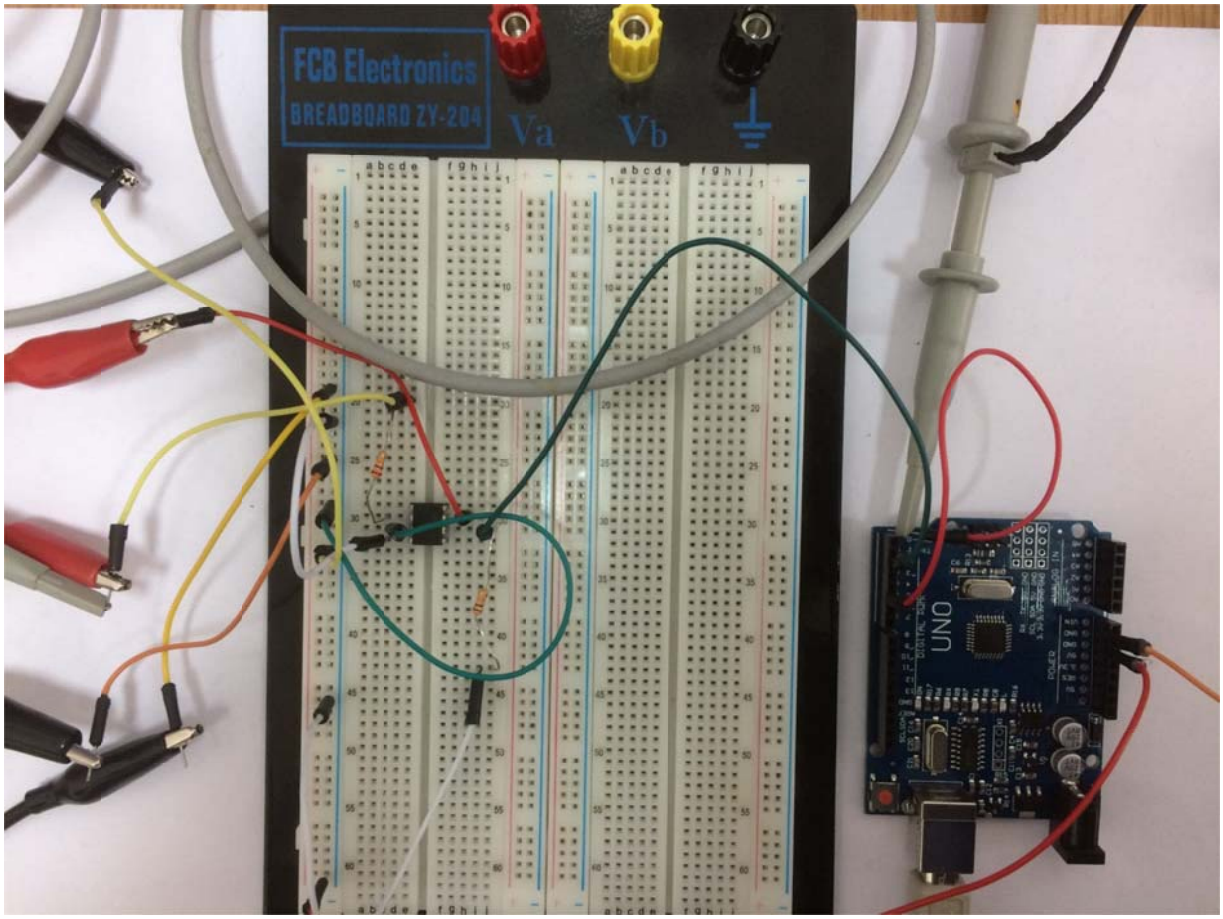
Kod:

Za rešenje ovog problema i realizovanje detektora nule, korišćen je sledeći Arduino kod:

```
#define triacPulse 5
#define SW 2
intval;
void setup() {

pinMode(triacPulse, OUTPUT);
pinMode(SW, INPUT_PULLUP);

attachInterrupt(digitalPinToInterrupt(SW),acon, CHANGE);
 //attachInterrupt(digitalPinToInterrupt(SW),acon, RISING);
Serial.begin(9600);
 }
void loop() {
 }
voidacon()
 {
Serial.println(SW);
digitalWrite(triacPulse, HIGH);
delayMicroseconds(10);
digitalWrite(triacPulse, LOW);
delayMicroseconds(10);
 }
```



Slika 2. Detektor nule. Oscilogram.



Slika 3. Zero crossing detector šema

Grupa3-4 Paljenje tiristora/triaka

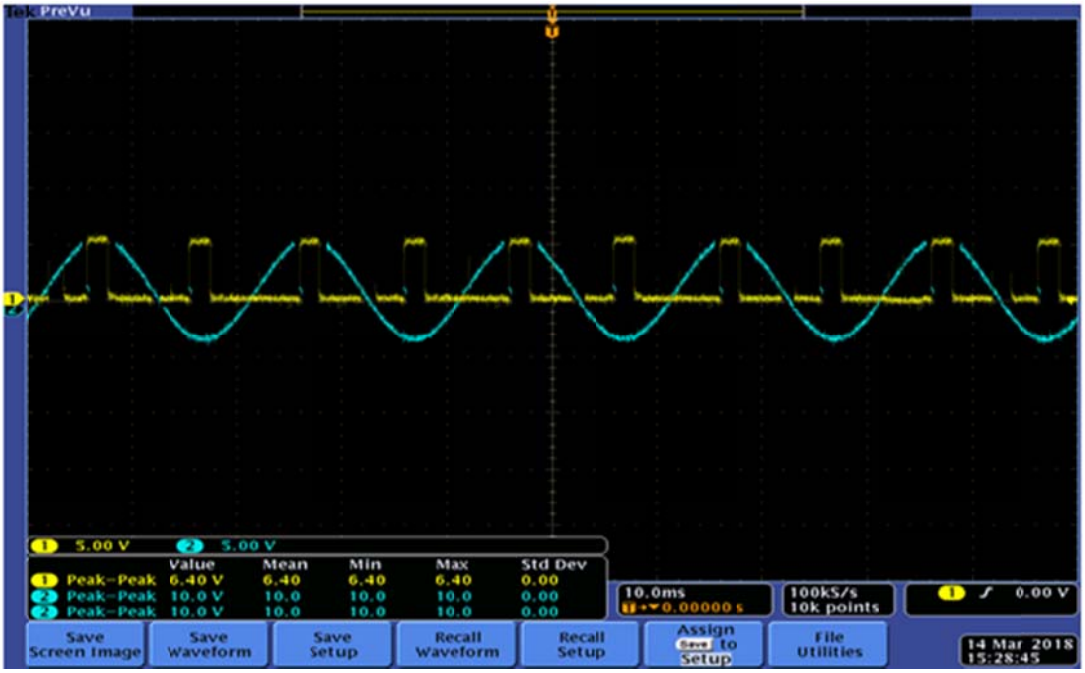
Abstract:

TRIAC, from **triode for alternating current**, is a generic trademark for a three terminal electronic component that conducts current in either direction when triggered. Its formal name is bidirectional triode thyristor or bilateral triode thyristor. A thyristor is analogous to a relay in that a small voltage and current can control a much larger voltage and current.
Triac firing angle control circuit is designed to control flow of **AC power** from input supply to load by changing the average voltage appearing across load. In this project triac firing angle is controlled to control amount of power flow to load. Firing angle control circuit is designed using analog **electronics components** like operational amplifier, resistor and capacitor.

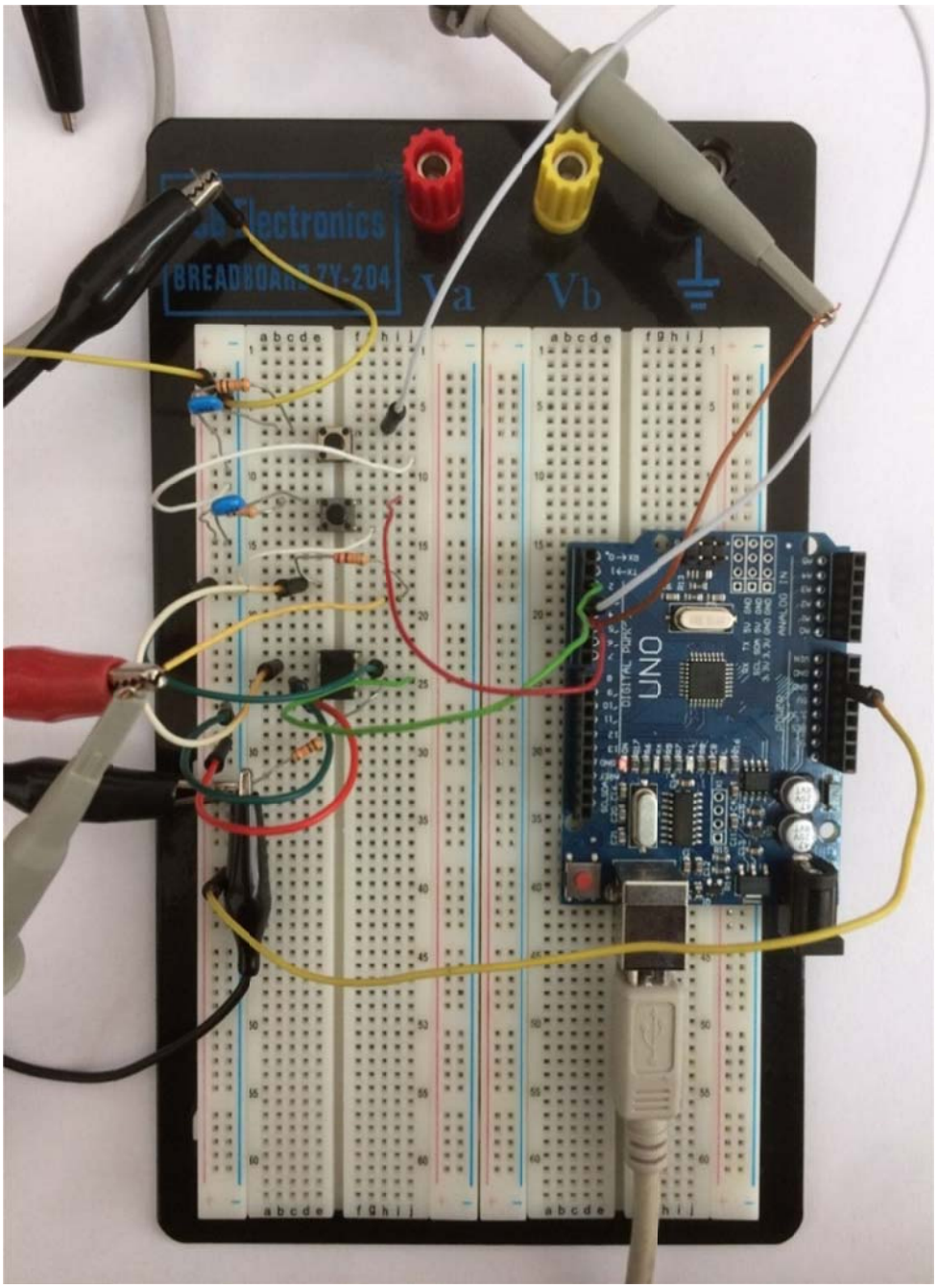
Kod:

```
#define triacPulse 5
#define SW 2
#define SW3 3
#define SW4 4

intprev_state = 1;
int state = 1;
int prev_state1 = 1;
int state1 = 1;
int delay1 = 0;
intval;
int a=0;
intaprev=0;
void setup() {

pinMode(triacPulse, OUTPUT);
pinMode(SW, INPUT);
digitalWrite(SW, HIGH);

Serial.begin(9600);
 }
void loop() {
 // check for SW closed
if (!digitalRead(SW)) {
 // enable power
attachInterrupt(digitalPinToInterrupt(SW), acon, FALLING);

 } // end if
/* else if (digitalRead(SW)) {
attachInterrupt(digitalPinToInterrupt(SW), acon, RISING);

 } // else*/
```

```
state = digitalRead(SW3);
if(prev_state == 1 && state == 0){
delay1++;
if(delay1>900){
   delay1=900;
   }
prev_state == state;
 a=state;}
else
prev_state = state;

 state1 = digitalRead(SW4);
if(prev_state1 == 1 && state1 == 0){
 delay1 = delay1 == 0 ?0 : (delay1 - 1);
 prev_state1 == state1;
 a=state1;}
else
 prev_state1 = state1;
Serial.println(delay1);

 } // end loop


// begin ac int routine
// delay() will not work!
voidacon()
 {
if(aprev = !a){
delayMicroseconds(10*delay1);
aprev=a;
 }
digitalWrite(triacPulse, HIGH);
delayMicroseconds(50);
 // delay 50 uSec on output pulse to turn on triac
digitalWrite(triacPulse, LOW);

 }
```



Slika 4. Paljenje tiristora/triaka. Oscilogram.



Slika 5. Tiristor/triak šema

Reference

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Grupa I:

1. DankoPetric
2. VesnaMandic
3. Ivan Martinovic

Grupa II:

1. KalezicMirko
2. Marija Milinkovic
3. Tamara Koljensic

Grupa III

1. PejovicSavo
2. AndrovicBozidar
3. MarjanaJovanovic
4. Boris Turkovic